DATA QUALITY SUMMARY REPORT FOR NITROGEN DIOXIDE DATA COLLECTED BY SONOMA TECHNOLOGY, INC., DURING THE CALIFORNIA REGIONAL $PM_{10}/PM_{2.5}$ AIR QUALITY STUDY

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1. INTRODUCTION AND OBJECTIVES

The purpose of this Data Quality Summary Report is to provide data users with an understanding of the quality of nitrogen dioxide (NO_2) data collected by Sonoma Technology, Inc. (STI) for the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS). **Table L-1** summarizes the operating sites and times for NO_2 concentration measurements during CRPAQS. This report provides summary information on data completeness, lower quantifiable limit (LQL), accuracy, and precision. NO_2 concentrations were measured with 1-minute time resolution and averaged to 5-minute and 60-minute values; only these latter values were reported in the corresponding database and reports. Data completeness and LQL were calculated for both data sets, while accuracy and precision were calculated using nightly NO calibration data from the NO/NO_y instrument and are applicable to both 5-minute and 60-minute data. Data completeness was calculated for all sites based on data delivered to ARB; the start date/time indicates the beginning of valid data, continuous until the stop date/time. Data validation suggested that all PAN/NO_2 instruments performed similarly; thus, Angiola was used as a representative site to calculate LQL and precision for all PAN/NO_2 monitors operated by STI in the study. Accuracy was not calculated for NO_2.

Table L-1. Location and duration of PAN/NO_2 measurements performed by STI during CRPAQS.

Site	Start Date/Time	Stop Date/Time
Angiola Trailer	11/19/00 14:45 PST	2/12/01 13:00 PST
Bakersfield	10/11/00 10:20 PST	2/12/01 9:30 PST
Bethel Island	11/22/00 14:20 PST	2/12/01 18:30 PST
Sierra Nevada Foothills	11/10/00 13:30 PST	2/13/01 14:35 PST

Several other documents are available from which to obtain information about the CRPAQS field study and data processing. Sampling locations are described in Wittig et al. (2003). Quality control screening procedures are summarized by Hafner et al. (2003). Results of systems and performance audits and intercomparisons are provided by Bush et al. (2001).

No data quality objectives (DQOs) were available for NO_2 measurements by the PAN/NO_2 instrument.

2. DATA COMPLETENESS

Data completeness for 5-minute and 60-minute NO_2 data is shown in **Table L-2**. Data capture quantifies the percentage of total records received versus the number expected during the "period of operation" defined by the start and stop dates/times in Table L-1; the start date/time is the first instance of valid data, and the period of operation is continuous until the stop date/time. The number of valid data points is divided by the number of captured data points to calculate the

data recovery. Validity is defined for this calculation as any data point that has a quality control flag of V0 (valid) or V1 (valid but comprised wholly or partially of below-MDL data). Details of data validation are included in Hafner et al. (2003).

Table L-2. Data completeness values for NO_2 at each site.

Monitoring Site	Total No. of Records	Expected No. of Records	Percent Capture[a]	No. of Valid Records	Percent Recovery[b]	No. of Suspect Records	No. of Invalid Records	No. of Missing Records
Angiola Trailer (5-min)	24,460	24,460	100%	4792	20%	8870	7222	3576
Angiola Trailer (60-min)	2040	2040	100%	517	25%	949	294	280
Bakersfield (5-min)	35,703	35,703	100%	15,984	45%	8855	10,612	252
Bakersfield (60-min)	2976	2976	100%	1652	56%	897	417	10
Bethel Island (5-min)	23,667	23,667	100%	11,065	47%	6783	5359	460
Bethel Island (60-min)	1973	1973	100%	1163	59%	708	67	35
Sierra Nevada Foothills (5-min)	27,374	27,374	100%	8065	29%	11,840	7196	273
Sierra Nevada Foothills (60-min)	2282	2282	100%	797	35%	1208	257	20

[a] % of capture = total number of records/expected records*100%
[b] % recovery = number of valid records/total number of records

All sites had a 100% data capture rate. Data recovery rates ranged from 20% (Angiola, 5-minute) to 59% (Bethel Island, 60-minute).

3. LOWER QUANTIFIABLE LIMIT

The LQL is the lowest concentration in ambient air that can be measured when processing actual samples. Sources of variability that influence the monitored signal at low concentrations include instrument noise and atmospheric variability. As a measure of this variability, two times the standard deviation of selected 5-minute and 60-minute data was used to estimate the LQL. The selected data were collected during relatively stable periods with concentrations close to zero. This is a conservative estimate of the LQL because it includes the

concentration variability of the ambient air. Twelve consecutive data values were used to compute the LQL with the 5-minute data and six data values with the 60-minute data; atmospheric variation generally becomes too great after six hours to calculate a reasonable LQL. Since only half the number of data values were used in the calculation (see "N" in Equation 3-1), the 60-minute LQL is expected to be higher than the 5-minute LQL, despite the "smoothing" that occurs when averaging 5-minute to 60-minute values.

The LQL is calculated as shown in Equation L-1. **Table L-3** shows the LQL for the sampling period, as well as the specific data strings used to calculate the LQLs.

$$\text{LQL} \approx 2s = 2\sqrt{\frac{\sum (NO_2 - \overline{NO_2})^2}{N-1}} \qquad \textbf{(L-1)}$$

where:

$\overline{NO_2}$ = mean NO_2 concentration
N = number of measurements
σ = standard deviation

Table L-3. Time period used to calculate LQL, the LQL, and the corresponding mean NO_2 concentration during the selected time period.

Type of Data	Time Period Used in LQL Calculation	LQL (ppb)	Mean (ppb)
5-minute	1/10/01 22:50 – 23:50 PST	0.19	0.50
60-minute	12/16/00 11:00 – 17:00 PST	0.52	1.65

4. ACCURACY

The accuracy of the NO_2 data from the PAN/NO_2 instrument was not evaluated. The data processing for the NO_2 was complicated, and the resulting data were not compatible with the accuracy estimate approach used in these DQSRs.

5. PRECISION

Precision can be measured for the NO_2 concentration by evaluating the variance of NO_2 concentrations during a period of low variability, when atmospheric influence on variability is assumed to be minimal. Data collected during periods of low variability, but when concentrations were well above the LQL, were selected. The precision was then evaluated by calculating the coefficient of variation (CV) during the period of low variability, as shown in Equation L-2.

$$\text{Precision} \approx \text{CV} = \frac{\sigma_{\text{measured}}}{\left[\overline{NO_2}\right]_{\text{measured}}} \times 100\% \qquad \textbf{(L-2)}$$

where:

$$\sigma_{\text{measured}} = \sqrt{\frac{\sum \left([NO_2]_{\text{measured}} - \left[\overline{NO_2}\right]_{\text{measured}} \right)^2}{N - 1}}$$

All the NO_2 concentrations in Equation L-3 refer to the concentrations measured during the selected time period. **Table L-4** shows the precision calculated for the representative site, Angiola.

Table L-4. Precision, the number of data points, time period, and mean of the data used to calculate the precision of the NO_2 data at the representative site, Angiola.

No. of Data Points Used	Time Period	Mean	Precision
15	1/7/01 1430 – 1545 PST	17.2	2.7%
6	1/10/01 2:00 – 7:00 PST	8.4	7.9%

6. REFERENCES

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